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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/536,781
Filing Date: October 11, 2005
Appellant(s): SCHOFIELD, NIGEL PAUL

Ting-Mao Chao
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 23 November 2010 appealing from the Office action mailed 18 March 2010.

(1) Real Party in Interest

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The following is a list of claims that are rejected and pending in the application:

Claims 1, 3-5, 7-11, 16, 18 and 19 are pending.

Claims 1, 3-5, 7-11, 16, 18 and 19 are rejected.

(4) Status of Amendments After Final

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

(5) Summary of Claimed Subject Matter

The examiner has no comment on the summary of claimed subject matter contained in the brief.

(6) Grounds of Rejection to be Reviewed on Appeal

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being

maintained by the examiner except for the grounds of rejection (if any) listed under the subheading “WITHDRAWN REJECTIONS.” New grounds of rejection (if any) are provided under the subheading “NEW GROUNDS OF REJECTION.”

(7) Claims Appendix

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant’s brief.

(8) Evidence Relied Upon

5893702	CONRAD	4-1999
6135709	STONES	10/2000
4465434	ROURK	8-1984
5848873	SCHOFIELD	12-1998

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 3-5, 7, 8, and 16 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over US Patent 5,893,702 to Conrad et al. (Conrad hereafter).

Regarding claim 1, Conrad teaches a vacuum pumping arrangement comprising a turbomolecular pumping mechanism (20) having a rotor (not labeled, clearly shown in Fig. 6) comprising a rotor body and rotor blades extending radially outward from the rotor body as shown below:

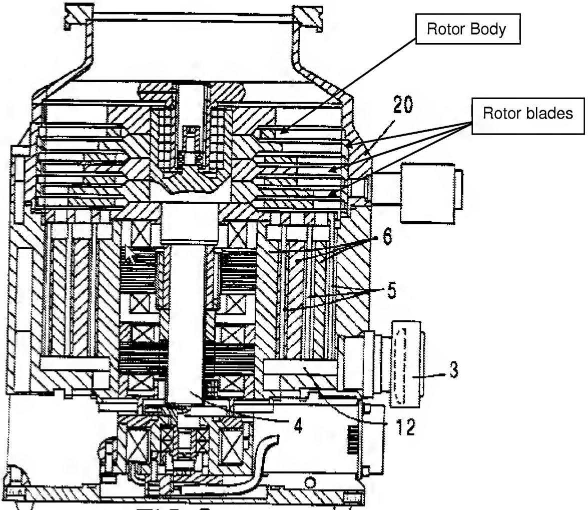


FIG.6

Conrad also teaches a molecular drag pumping mechanism (5) and various connection elements (10, see particularly the embodiment of Fig. 3) for connecting the drag pumping mechanism's cylindrical elements together and to the rotor. As shown in Fig. 3, the connection element may comprise rotor vanes such as those of the turbomolecular pumping stage (20). As such, the rotor blades are provided with an annular ring (within the axial extent of the blades, or at least at their intersection with the drag pump rotors 5) to which is affixed the rotors (5) of the drag pumping mechanism. In other words, while not explicitly shown, the drag pump rotors (5) must be attached in some fashion to the blades (14) of the connection element (11). Since the drag pump rotors (5) are themselves annular rings, the blades are connected to a non-pumping upper annular ring section of the drag pump rotors which is attached to the pumping sections of the drag pump by integral formation. The ring, and the molecular drag pumping mechanism are provided coaxially with the rotor body and within the radial extent of the rotor blades. The examiner believes that this disclosure anticipates the claimed invention, since the connection element (10) is discussed in several embodiments, and no particular embodiment is described as being utilized in the combined turbomolecular and drag pumping system of Fig. 6. However, Conrad further teaches that the drag pumping mechanism advantages "become particularly noticeable when it is used in combination with a turbomolecular pump," (col. 3, ln. 20-21). As such, it would have been obvious to one of ordinary skill in the art to combine a drag pumping mechanism as in Fig. 3 of Conrad with a turbomolecular pumping mechanism as shown in Fig. 6 in order to more fully realize the benefits of Conrad's invention.

Regarding claim 3, as shown in Fig. 6, the turbomolecular pumping mechanism has multiple stages. In utilizing the connection element (10) of Fig. 3, the element would constitute the last stage of the turbomolecular pumping mechanism.

Regarding claim 4, as shown in Fig. 6, the drag pumping sections are supported approximately halfway along the radial extent of the turbomolecular blade sections. The examiner notes that there are several drag pump rotors (5) shown in Fig. 6, and that "approximately" significantly widens the locations which satisfy the language of the claim.

Regarding claim 5, as shown in Fig. 6, the drag pumping section has a plurality of rotors (5) affixed to the rotor blades (10).

Regarding claim 7, as shown in Figs. 1 and 6, each rotor (5) of the drag pumping mechanism has a pumping path radially inward thereof and a parallel path radially outward.

Regarding claims 8 and 16, as shown in Figs. 1 and 6, the drag pumping mechanism is of a Holweck type.

Claims 9, 18, and 19 rejected under 35 U.S.C. 103(a) as being unpatentable over Conrad as applied to their respective parent claims above, and further in view of US Patent 6,135,709 to Stones (Stones).

Regarding claims 9, 18, and 19, Conrad does not teach a second molecular drag pumping mechanism supported on the rotor of a regenerative pumping mechanism. Stones teaches a vacuum pump, particularly teaching a turbomolecular pump followed

in series by a Holweck type drag pump (2) mounted on the rotor of a regenerative pump (1). Stones teaches that hybrid or compound vacuum pumps combining different pump types can improve overall operating range and throughput of a particular pumping installation (col. 1, ln. 4-8). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the pump of Conrad with further stages such as a molecular drag pump mounted on a regenerative pump rotor as taught by Stones in order to improve overall operating range and throughput.

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Conrad as applied to claim 1 above, and further in view of US Patent 4,465,434 to Rourk (Rourk).

Conrad substantially teaches the invention of claim 1 from which claim 10 depends, as discussed in the above rejection of claim 1. However, Conrad does not teach the use of specific materials in his vacuum pump. However, it is known that turbomolecular and molecular drag pumps generate heat. Rourk teaches a carbon fiber composite turbine wheel, and that the use of carbon fiber composites increases the temperature at which a rotor may operate. Rourk further teaches that in his particular structure, "interlaminar shear stress associated with load transfer from radial to circumferential is minimized," (col. 2, ln. 3-5). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form the rotor of the molecular drag pump of Conrad from a carbon fiber composite as taught by Rourk in order to increase heat resistance and minimize interlaminar shear stress.

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Conrad as applied to claim 1 above, and further in view of US Patent 5,230,924 to Schofield (Schofield).

Conrad substantially teaches the invention of claims 1 and 2 from which claim 11 depends, as discussed in the above rejection of claim 1. Conrad does not teach the use of specific materials in his vacuum pump. Schofield teaches that aluminum is generally useful for compound vacuum pumps (col. 3, ln. 26-29). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use aluminum to form elements of the vacuum pump of Conrad.

(10) Response to Argument

The instant invention is directed to a compound vacuum pump, particularly a vacuum pump combining a turbomolecular pump with a molecular drag pump. These pumps are used to generate relatively high vacuum levels using different principles. Turbomolecular pumps rely on a Newtonian interaction between a spinning rotor blade and individual gas particles. Molecular drag pumps use rotating cylinders to motivate gas flows due friction between the gas and the cylinder. The applicant has provided a structure to directly mount a drag pump cylinder to the blades of a turbomolecular pump, using an annular ring attached to the blades as a mounting point for the cylinder. In this appeal, applicant generally contends that the prior art does not teach or render obvious a drag pump rotor attached to the blades of a turbomolecular pump, and that particularly an annular ring is not taught for such attachment.

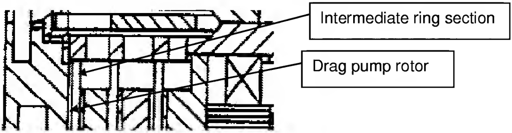
Conrad is generally directed to a gas friction pump, a term which is synonymous with the "molecular drag pump" terminology used by the applicant. In particular, Conrad teaches a number of structures for mounting the drag pump rotors (see Figs. 1-4 and 6), including a bladed structure as shown in Fig. 3. Since Conrad also teaches a compound vacuum pump (Fig. 6) including both an upper turbomolecular pumping stage (20) and a gas friction stage (5, 6), it is apparent that Conrad explicitly discloses an embodiment where rotors of a turbomolecular pump and of a gas friction pump are fixed to a common shaft (4) to co-rotate with each other (col. 4, ln. 36-41). While Conrad does not explicitly show the bladed mounting structure of Fig. 3 with the drag pump rotors, it is clear from the disclosure that mounting the drag pump rotors to the blades is an intended variation of Conrad's invention (col. 4, ln. 23-24, "In the connection element of Fig. 3").

The applicant first argues that "[s]ince the connection element 10 is not part of the turbomolecular pump 20, it does not function as a rotor of the same," (Appeal Brief, page 7). Applicant also argues that the pressure or viscosity of the gas in the vicinity of the connection element may be too high to permit turbomolecular pumping, or that the strength, configuration, or spatial relationship may not be sufficient for turbomolecular pumping. However, a turbomolecular pump operates on a relatively simple principle, whereby the blades of the pump interact with individual atoms or molecules of the gas on an essentially Newtonian basis, i.e. by kicking individual gas particles downstream. It follows then that inclined blades affixed to and rotating with the rotor of a turbomolecular pump, as would be the case in the compound pump of Conrad's Fig. 6,

will exhibit a turbomolecular pumping effect due to their angled orientation as shown and described in combination with their rotation at the same angular velocity as the explicitly provided turbomolecular pump rotor. This addresses the concern that the spatial relationship may not be sufficient for turbomolecular pumping. With respect to the argument that the connection element does not possess sufficient strength, Conrad intends the connection element of Fig. 3 to support multiple drag pump rotors. One of ordinary skill in the art would expect the structural load from that application to exceed by far any pressure or reaction forces resulting from a turbomolecular pumping action. With respect to the argument that the pressure or viscosity would be too high, the examiner notes that in the compound pump of Fig. 6, the connection element is placed at the end of a turbomolecular pumping section. This indicates that the pressure and viscosity in the vicinity of the connection element would be within the range permitting turbomolecular pumping during normal operation of the pump. Furthermore, Conrad generally recognizes that vacuum pumps are called to operate in a variety of suction pressure conditions, as evidenced by his desire to increase the upper limits of the pressure ranges possible (col. 2, ln. 7-12). Thus, it would also be possible to operate Conrad's pump at a lower suction pressure than it's designed maximum, at which operating point the outlet pressure and viscosity from the explicitly provided turbomolecular section would be expected to be even more suitable to turbomolecular pumping by the blades (14) of the connection element.

The applicant also argues that Conrad does not suggest an interface component similar to the claimed ring. This argument is based on a misunderstanding of the

examiner's position. The examiner is not proposing any annular ring beyond those of the drag pump rotors (5). Instead, the examiner simply notes that the blades (14) of Fig. 3 are explicitly those of a connection element, which according to the disclosure of Conrad, are intended to support the rotors of a drag pump. Clearly, some form of connection between the blades and the drag pump rotors must inherently be included to provide the support, though there is not an explicit provision of a structure to accomplish this, as there is with the bearings (13) in Figs. 1 and 2. So, in the language of claim 1, the rotor blades (14) are provided with an annular ring (any one of drag pump rotors 5, or an upper section thereof). The examiner notes that several interpretations of the claim language are possible. For instance, an outer one of the drag pump rotors (5) could be considered the annular ring, and one of the other rotors could be considered the claimed drag pump rotor, since they are mutually fixed to each other via the connection element 14. Or alternatively, an upper section of an individual rotor (5), either similar to the bearings (13) of Fig. 3, or an intermediate section as shown in the section of Fig. 6 shown below, may be considered the annular ring to which the operative section of the drag pump rotor is fixed by integral formation therewith.



In either interpretation, the claim language is satisfied without relying on a suggestion to provide a further element, contrary to the applicant's assertion. As such, the arguments made by the applicant pointing out the supposed absence of the claimed

annular ring or a supposed lack of motivation for such a providing such do not address the position taken by the examiner in the rejection of claim 1. Further, and as discussed above, the argument that because the blades (14) of Conrad are those of a connection mechanism rather than a turbomolecular pump is addressed by the expected turbomolecular pumping behavior of the vanes in their proposed location within the pump.

The applicant also argues that "[t]here are many configurations to connect [the drag pump rotors and the connection element], without a ring-shaped interface component," (Appeal Brief, page 10). While this argument still improperly attempts to argue against the provision of a ring-shaped interface component as is discussed above, there are several factual errors which the examiner will address. First, the applicant discusses Figs. 1 and 3 of Conrad, and the connection between the cylindrical elements (5) and the "vanes of the connection element 10." The examiner notes that the connection element (10) of Fig. 1 does not have vanes, and that Fig. 3 does not show the connection to the cylindrical elements. More importantly, however, the applicant appears to miss the significance of the bearings (13) in Fig. 1, which, in a cross-sectional view such as that of Fig. 1, appear to be substantially ring-shaped. Thus, over and above the rejection explicitly made by the examiner, the bearings provide at least a suggestion that a ring-shaped interface could be used to connect the connection element and the drag pump rotors. Conversely, the various alternate mounting structures proposed by the applicant are without basis in the disclosure of Conrad. It could thus be argued, though this position is not relied upon by the

examiner, that the bearings (13) provide a basis for one of ordinary skill in the art to provide a ring-shaped interface element to the blades (14) of Fig. 3, contrary to the applicant's assertions of a lack of such a suggestion.

Finally, the examiner notes the broad scope of claim 1 as currently drafted. In particular, the sole limitations on the relation between the rotor of the drag pump mechanism and the turbomolecular pump mechanism are that the drag pump rotor is "affixed to the rotor blades of the turbomolecular pumping mechanism," and that the rotor blades "are provided with an annular ring, disposed co-axially with the rotor body and positioned between two ends of each of the rotor blades in an axial direction, to which the rotor of the molecular drag pumping mechanism is fixed." In particular, the examiner notes that the axial location of the claimed annular ring is in no way limited, so long as it is coaxial with the turbomolecular pump. There is therefore no limitation requiring the blades and the ring to overlap along an axial direction. Since the outer drag pump rotor of Conrad meets the coaxial and radial structural limitations required by the claim, the remaining structural limitations are only limited by “affixed to,” “provided with” and “is fixed.” These terms, read with an eye toward a reasonably broad scope, read on the unmodified Fig. 6 of Conrad. In particular, since the drag pump and turbomolecular pump are “mounted on a common shaft” (col. 4, ln. 41), they can be considered to fulfill the mutual affixment and provision language of claim 1.

The remaining rejections are only addressed in light of the dependence from claim 1 of the claims to which they are addressed. As such, those rejections will stand or fall with the rejection of claim 1.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Philip Stimpert/

Examiner, Art Unit 3746

Conferees:

/Devon C Kramer/

Supervisory Patent Examiner, Art Unit 3746

/Sue Lao/

Primary Examiner